

Clothing recycling as new value into Fashion cycle

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Abstract

This work comes from the PhD course research on Sustainability in Apparel Design aiming to promote the concept of circular economy in Fast Fashion Cycle. It intends to show how it is possible to create value through the processing of discarded garment to produce raw materials and introduce them again into another cycle of clothing.

Although the proposal work involves concepts related to solid waste management and sequential transformation processes, it aims above all to contribute to a more sustainable fashion design which the selection of materials can incorporate salvaged materials in place of virgin materials. At first we will present the impor-

tance of the materials stage of the Garment Life Cycle to understand better the way clothes can be recovered. The results we intend to show are textile experiments from unwanted clothing (discarded) are made up from natural fibers, more particularly in cotton or wool.

The research will work according to European legislation in matter of waste recovery, being a priority the laboratory tests continuity to improve the quality of materials will be obtain.

Keywords

Sustainability, Clothing design, Recovery, Recycling, Life cycle

Background

Considering the fast-fashion one of the biggest environmental problems in the landfill disposition of waste, performing strategies to minimize all impacts and valuing textile waste that will be considered into another lifecycle is an act of great urgency, especially in an area which there are so much diversity of materials and processes (Fletcher and Grose, 2012). A garment collection covers multiple products and each one belongs to a specific Lifecycle. Therefore, only a clothing collection have multiple lifetimes because each garment is made up of one type of material, it is produced by specific machines and it is used or discarded according to a consumer/user owns way care (Morais, 2013).

The issue of raw materials in traditional clothing chain is also not simple because a fabric production carried out many operations and it may be woven or nonwoven. For woven materials is required that fibers may be transformed into yarns and for unwoven materials it doesn't need at all: fibers are directly used on a nonwoven material processing (Collier and Tortora, 2001).

In the fast fashion or high street brands the most used fabrics surfaces are produced by the

weaving process or by the knitting process. For both methods it must be used fibers (which may be natural, artificial or synthetic) and yarns.

Actually, there is a textile material recovery process to produce a kind of materials which does not require yarns production but usually these materials are incorporated in other types of products such as heat insulation, fillers furniture, automobile industry, etc. This type of recycling process does not require a careful quality as those would demand in the clothing industry. Therefore, is a challenging developing a recycling loop that goes around and comes around Fashion Cycle.

In the last years some industrial companies have elaborated a textile loop but this recovery is only made in specific materials, such as polyester.

Methods

Garment Lifecycle Assessment

Successful design projects are compatible with the best management practices and with a careful Lifecycle Management (SETAC, 2007). So we

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need to firstly introduce the importance of Materials and Design phases on the Garment Lifecycle.

The traditional Garment Life Cycle is based on a linear model, which the resources are extracted in masse, manufactured into garments, supplied to retailers, and then sold to consumers, who rapidly dispose of them to purchase a new product.

Design phase is usually represented as a specific stage before the Garment manufacturing phase and after a Materials phase (Gwilt, 2014) but it should be placed where there is a Product Development. In Fashion industry there is a product development in all steps until the garment manufacturing. Therefore, Materials phase must be separated in Fibers, Yarns and Fabrics phases because each one is very important for the final product performance. Proprieties of some garments, such as color, smell or even the ability to breathe better depends on Fibers phase, for example. Thus, Design phase is displayed by an orange spot between Yarns and Garment phases as shown in figure 1.

All type of products have a similar processing way being different in the type of the materials are used.

According to Ashby (2009, p.10) “we consume roughly 10 billion (10^{10}) tones of engineering materials per year” and despite of the average level of global materials consumption is decreasing, per-capita consumption is growing more quickly because the emerging economies. Textiles materials are just a small part of all these materials which society depends on. Fast fashion is one of the biggest environmental problems be-

ing necessary initiatives between designers and producers focusing on textile waste to reduce its impact. Using textile waste or discarded clothing to create value into a Garment Lifecycle changes the view of product’s lifecycle and it goes according to the «cradle to cradle» philosophy (Braungart, 2002).

Textile waste management strategies

The textile waste sector has had a long history of recovery working. Rag collectors and shoddy manufacturers have been reusing and recycling fibers for hundreds of years as well as individuals have been repairing and reconditioning their own household’s textiles and garments for next generations. But despite these actions most textiles are recycled into low-quality end-uses because of the lack of technological innovation in the recycling industry and the market dominance of cheap virgin fibers (Fletcher, 2008).

Organized from the least to the most resource intensive, there are three main different textiles waste management strategies: Reusing, Upcycling and Downcycling.

Reusing strategy happens on products that have the same function than older ones which they come from. Examples of that are products resold as nearly new garments for second hand shops or markets in developing countries.

Upcycling is a type of reusing which happens on products that are already out of fashion and then they will be reworked into higher quality ones. Upcycling differs from Reusing because it

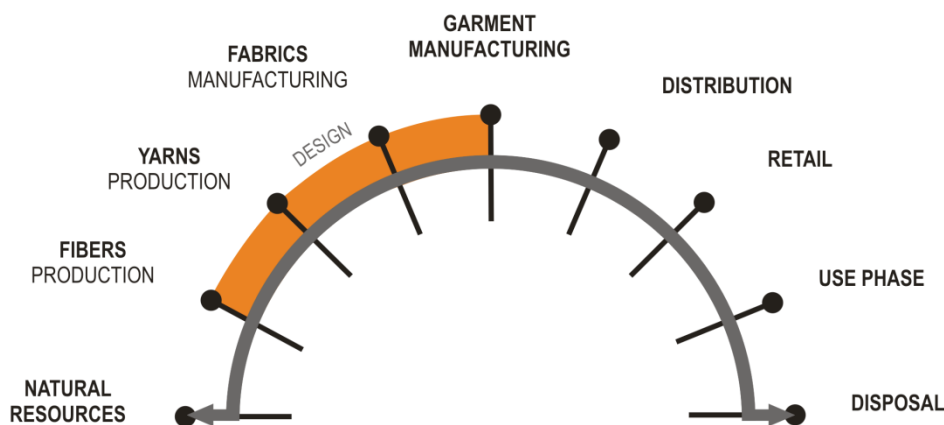


Figure 1 – Garment LifeCycle and Design phase displayed by an orange spot

needs of a Design Development Product. *Romance was Born*, from Somewhere and Junky Styling are companies that reuses textiles materials from unwanted clothing to make new garment.

Downcycling is a type of recycling, which materials are reused, disassembled and shredded to make lower quality products that don't have the same function of clothing, such as carpet underlay, mattress filling or insulation material.

Other alternatives

In addition to the waste management strategies there is already an effort in the manufacturing of renewable fibers such as Lyocell and Bamboo or biodegradable fibers such as PLA (polylactic acid fibers). Lyocell is a fiber made from wood pulp dissolved directly in amine oxide solvent (non-toxic) and extruded to form fibers. In its process more than 99,5 per cent of the solvent is recovered and reused. Bamboo is a fiber that has a quickly growing and regularly renewability but its industrial processing has high-impact waste emissions, as well as happens in all manufactured fibers. PLA fibers are biopolymers made from sugars mainly derived from corn that are melt-spun in a similar process to the conventional oil-based polyester (Fletcher and Grose, 2012). However these fibers only decompose in special conditionals and by industrial facility.

Proposal work

Nevertheless, we think we have to develop strategies to recycle those fibers are already in our wardrobes. Thus, our aim is recycle all clothing as much as possible to produce yarns again to be used for weaving and knitting fashion products. But for that it is necessary to have a good policy waste management after the clothing Disposal phase to identify and separate it by composition and color. Then we use a shredding machine to cut discarded clothing in small pieces like fibers and it will be produced the yarns with a carding machine. This mechanical recycling process offers a low-impact alternative to other fibers sources with reduced energy and chemical consumption, being more suitable for natural fibers. An advantage of that is a possibility to produce fabrics without going through the dyeing process, since this is one of the most pollutant finishing processes. Separating clothing by color it doesn't need to dye the yarns or fabrics will be produced.

Results

In cooperation with some national companies we developed experimental samples of yarns and fabrics that came from discarded clothing in natural fibers, wool and cotton.

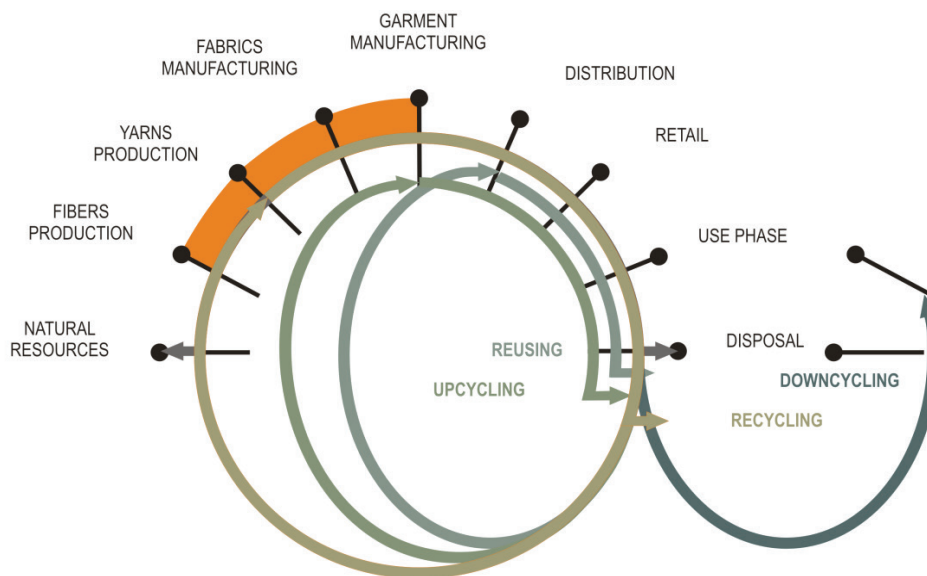


Figure 2 – Garment lifecycle displaying different waste management strategies¹.

¹ In Reusing strategy, the new lifecycle begins with a redistribution and resale phases. In Upcycling the new lifecycle begins at the "garment manufacturing" phase instead of distribution as happens with reusing. In Downcycling the new lifecycle begins in materials production of other product. Recycling strategy is the aim of this proposal work, closing the loop of Garment Lifecycle and making products for the same function of clothing.

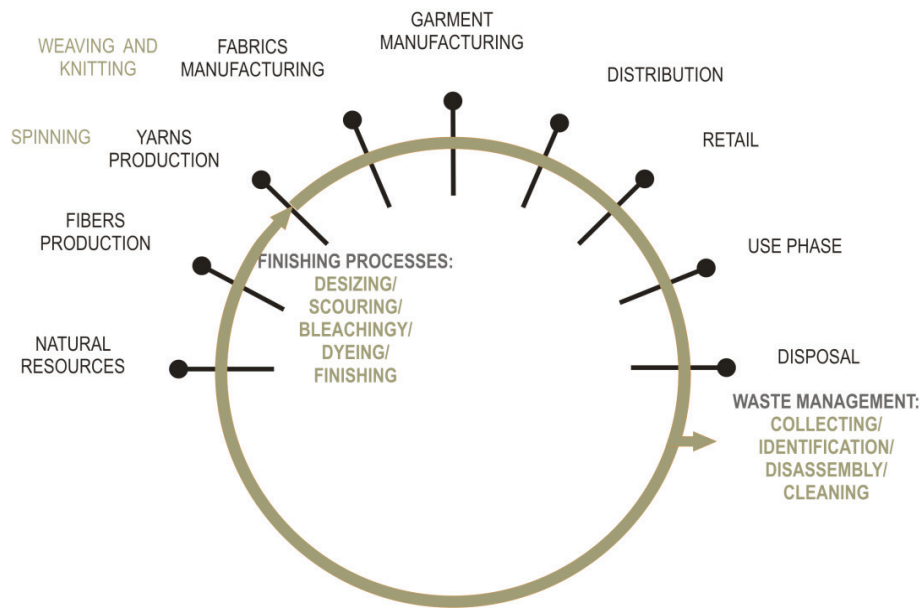


Figure 3 – Garment and Textiles Recycling Proposal Work

Mirafios company usually produces threads by open-end technology for textile market instead of fashion clothing market. Jomafil company reuses textile waste to produce materials such as mattress filling or automotive upholstery. Tavares Company produces all type of wool threads using carding machines for any textile or fashion market.

Ecolã company produces a Portuguese traditional fabric named burel, usually made with wool yarns.

Therefore, with Mirafios company we developed a green recycled cotton yarn from unwanted and discarded green t-shirts which after their shredding were mixed with 10 per cent of polyester fibers. After the recycled yarn made we drove to Minho University to use knitting machine and produce a green sample jersey knit. The result was positive because none of the needles from de knitting machine hindered the manufacturing process.

With Jomafil company we firstly ask for recycled wool fibers that came from discarded clothing to send to Tavares company to produce wool yarn. Tavares company made 70 per cent of recycled wool mixed with 30 per cent of polyester fibers. After this we went to Ecolã company to find out a possibility of weaving a fabric. We solved the weaving process introducing recycled wool yarns in the weft threads and wool virgin yarns in the warps threads to ensure the final fabric resistance.

Discussion

Recycling fibers

As with other waste management strategies such as reusing, upcycling and downcycling, clothing recycling saves resources, especially in the type of mechanical process. However, the method of extracting fibers from fabrics has not been developed. Most of the national Portuguese companies which working on it they are small, they don't have time to spend in innovation and have afraid to damaged their machines - a fact which reflects our fast fashion market that involves the dominance of cheap virgin fibers (Fletcher, 2008).

As it was explained in the results of this proposal we realize that it is possible to make woven and knitted fabrics with recycled cotton yarns and recycled wool yarns. Although it was tested a type of yarns which had taken a minimum percentage of polyester fibers to ensure the final fabric resistance we would like to keep going this working to try different resistances of yarns on different machines.

This process, that shreds clothes into fibers, has been made a long-time ago (in downcycling) but it is never used into fashion clothing because the fibers are usually produced tend to make a low quality yarn. The great challenge is to find longer fibers and develop quality to change this.

There is also a textile chemical recycling for main-made fibers which the most available is polyester (usually made from plastic bottles) but

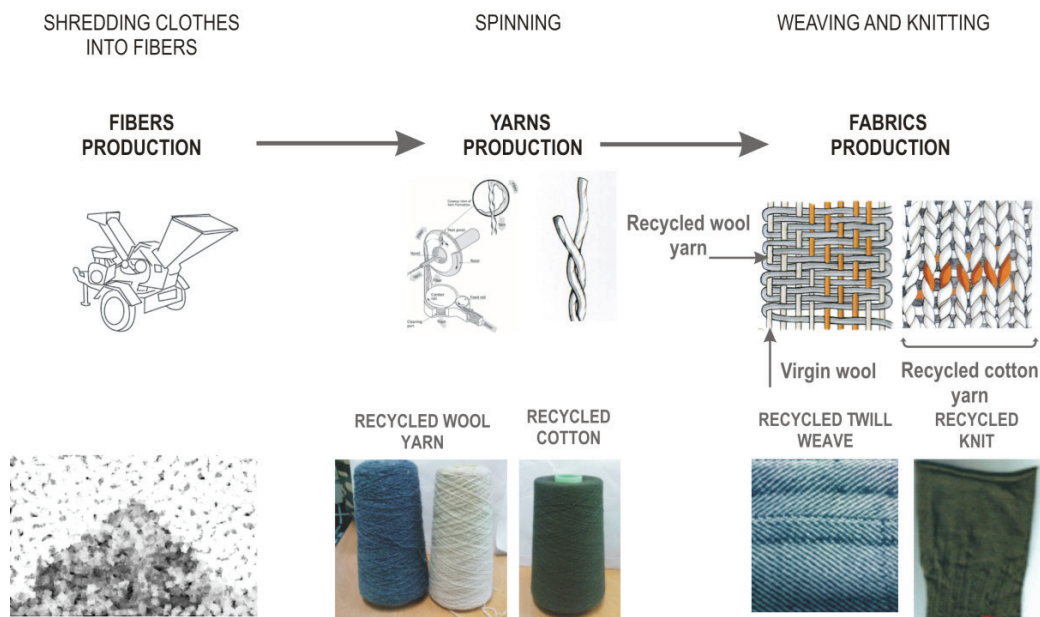


Figure 4 – Experimental samples of yarns and fabrics were produced

Source: authors' material

chemical recycling has got used more energy intensive than mechanical recycling in natural fibers – the major critiques related to the fibers recycling. So, the less energy it is spent since the beginning of natural fibers production, the less energy it will be spent in their fibers recovery. This is a valid data which maximizes embodied energy on recycling natural fibers comparing with the modern types of manufactured fibers.

Limitations

Despite of textiles being collected separately from other rubbish and being recycled, the great limitation is not connected with the activities of reworking fibers but with the wasteful industrial system.

The following scheme (in figure 5) shows different routing possibilities of discarded clothing that comes from Portuguese family homes, being difficult to calculate and reworking on them.

Conclusions

A garment system goal of zero waste influences all stakeholders of a supply chain: farmers, brokers, designers, producers, retailers and consumers but working on clothing recycling interests would influence others contributors from the Garment Lifecycle such as textile collectors.

The mechanical recycling process were pre-

sented has an effect on the types of materials and chemicals are used, being important to shred clothes only with cent percent of a fiber composition. This will contribute for a better waste recovery and even other similar market opportunity, as corporate garment, where we would find a great amount of clothing in the same color and same composition.

Recycled yarns, fabrics and clothes made with mechanical recycling process remain in a niche market until recycled materials will regularly be specified in mainstream products or until they will be banned from the landfill.

According to legislative framework that is forcing the progressive recovery of textiles this working proposal is a way to solve the environmental impact based on clothing that is discarded very quickly. It eliminates problems of overflowing landfill at the same time it will be a fundamental change in economic points of view, moving a linear system to a circular one where all resources becomes sources for new goods (Chapman, 2005; Fletcher and Grose, 2012).

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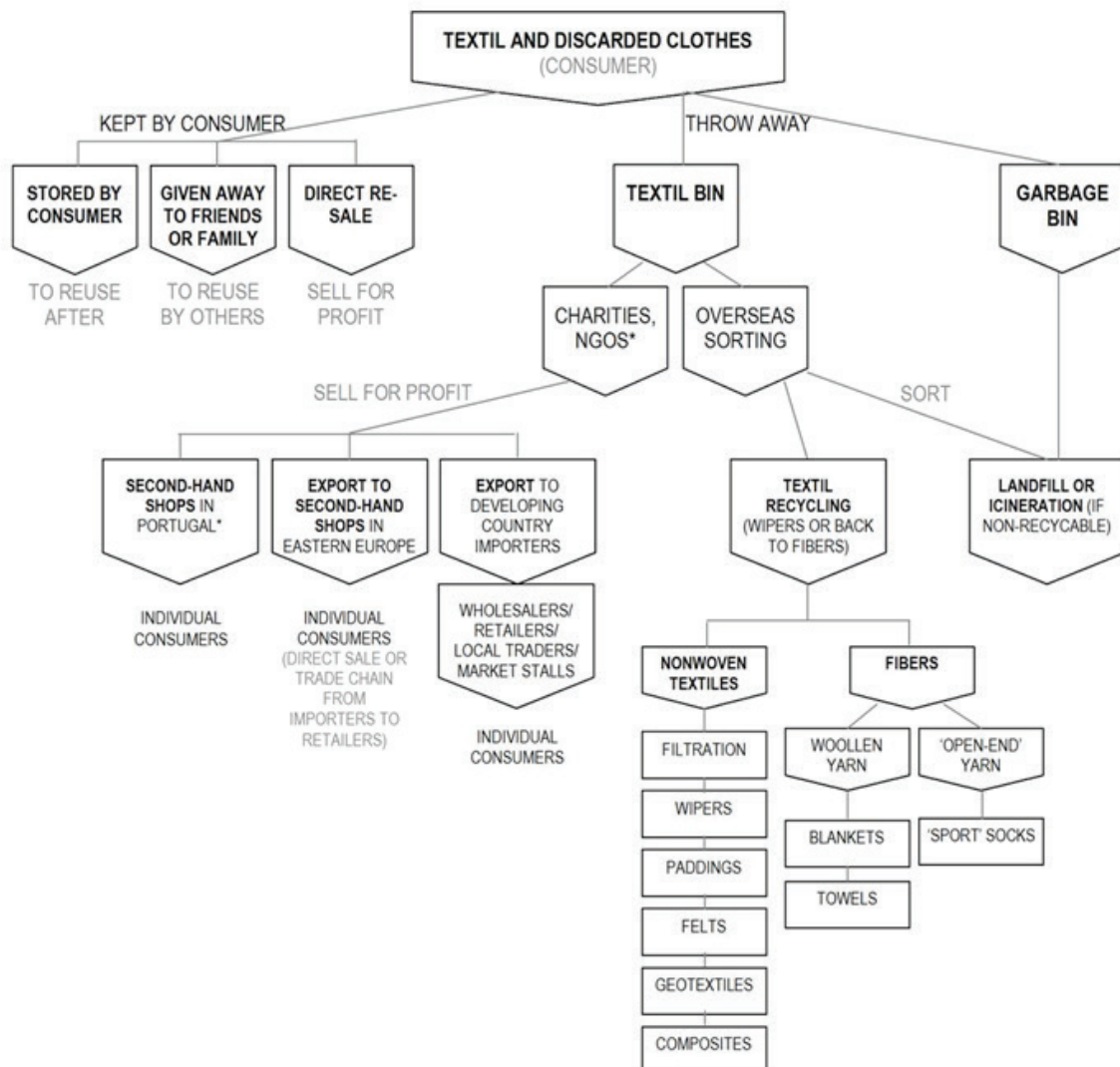


Figure 5 – Different routing possibilities of discarded clothing in Portugal²

Source: authors' material

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² It shows how it is very difficult to calculate all post textile waste, being very important to have a specific collecting waste such as door-to-door waste collection systems.